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THE ECONOMIC IMPORTANCE OF MONTANA REFINERIES AND PROJECTED IMPACTS OF CURTAILMENTS IN CANADIAN PETROLEUM IMPORTS

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THE ECONOMIC IMPORTANCE OF MONTANA REFINERIES AND PROJECTED IMPACTS OF CURTAILMENTS IN CANADIAN PETROLEUM IMPORTS

Prepared for

Montana Energy Advisory Council

By

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Introduction and Summary of Findings

The recent national and international energy crises have put Montana into the spotlight. Most attention has been directed toward the vast coal deposits in the eastern part of the state. But, Montana's energy industry also includes oil production and refining, natural gas processing, and hydroelectric generation. Recently, Montana's oil refineries have emerged from relative obscurity. Heavily dependent upon Canadian crude oil, they face a reduction in supply which could seriously affect their operations. This report takes a closer look at Montana's oil refineries, their contribution to the state and local economies, and the probable effects of reduced oil supplies.

Montana refineries represent a minor portion of the refinery capacity in the United States; during 1975, about 48 million barrels of crude oil, or slightly less than one percent of the national total, were processed in the state.

When measured in terms of capacity, Montana's refineries have increased three-fold since 1950. But, because of new technological processes, total employment has remained approximately constant. Nevertheless, refinery jobs are among the most attractive positions in Montana. Average annual earnings of refinery workers were well above the statewide average during 1973 and were probably among the best paying wage and salary positions in the state. In addition, the jobs are stable and most employees work full-time with few interruptions due to seasonal or cyclical factors.

There are currently seven operational refineries in Montana. Three large installations in Yellowstone County (Billings) represent about 90 percent of the industry, measured in terms of either refining capacity or employment. While refining plays only a minor role in the statewide economy, it represents almost 20 percent of the nonagricultural economic base in Yellowstone County. The smaller refineries, which are mostly located in rural communities, also constitute a significant portion of the local economic base.

The curtailment of Canadian imports is a very serious problem for Montana refineries because they received about 40 percent of their crude oil from these sources during 1975. Looking only at the effects of refinery closings--that is, assuming gasoline and other finished petroleum products are supplied to Montanans from other sources--the loss of Canadian crude oil with no replacement will lead to a statewide decline in total (primary plus derivative) employment of between 2,115 and 2,755 workers. The availability of Alaskan crude oil as a substitute for the Canadian imports to Montana refineries would significantly moderate these declines; a total of only 235 to 305 jobs would be lost. When compared to total employment in Montana, these decreases are relatively insignificant.

Looking only at the Billings area, however, the picture is not so rosy. If there is no replacement for the Canadian oil, total employment in Yellowstone County is projected to decline between 3.7 to 4.8 percent. If Alaskan crude oil would be available as a replacement for the Canadian imports, the projected employment declines would be less than one-half of one percent of total employment in Yellowstone County.

The proposed Northern Tier Pipeline could bring Alaskan crude oil to Montana. The building of this facility will provide a temporary stimulus to Montana's economy; total (primary plus derivative) employment is projected to increase by 1,950 to 2,660 workers during the two year construction period. The new permanent positions associated with the pipeline are projected to result in a long-run increase in total employment of only 48 to 63 workers, probably insufficient to counterbalance the jobs lost due to the inability of certain refineries to process Alaskan crude oil.

Current Conditions and Past Trends in Montana's Refining Industry

An Overview of Refining in Montana

Refineries have a long history in Montana, dating from the 1920s. As early as 1950, almost 16 million barrels of crude oil were refined in the state. Major expansions in the last twenty-five years have boosted production almost three-fold to about 48 million during 1975. Despite this rapid increase, Montana's refineries have done little more than kept pace with the nationwide growth in this industry; they remain a relatively small portion of the total refinery capacity in the nation. During 1974, the latest year nationwide data are available, crude oil refined in Montana represented about one percent of the total for the United States, only a marginal increase from the 0.76 percent reported in 1951.[1]

Montana refineries have long relied on out-of-state sources for significant portions of their crude oil. In fact, most of their growth has been dependent upon sources outside the state. Table 1 shows that the increased crude oil refined during the fifties and early sixties was derived about equally from Montana and Wyoming sources. But, the Montana figure peaked in 1964 and later growth was due to Wyoming sources and expanded imports from Canada. During 1975, Wyoming and Canada each accounted for about 40 percent of the crude oil refined in Montana with the remaining 20 percent coming from oil fields in the state.

The Elk Basin Field just across the state line is the major Wyoming source for the Montana refineries. This crude oil has no important pipeline

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[1] Montana Energy Advisory Council, "Historical Petroleum Statistics for Montana," mimeographed preliminary summary (Helena, Montana), table 6.

Table 1

Crude Oil Refined in Montana, by Source
1950-1975

	Total From All Sources (Thousands of Barrels)	Sources of Crude Oil					
		Montana		Wyoming		Canada	
		Barrels (Thousands)	*Percentage of Total*	Barrels (Thousands)	*Percentage of Total*	Barrels (Thousands)	*Percentage of Total*
1950	15,975	6,803	*42.6*	9,171	*57.4*	0	*0*
1951	17,941	7,236	*40.3*	10,705	*59.7*	0	*0*
1952	19,004	7,109	*37.4*	11,895	*62.6*	0	*0*
1953	19,609	7,497	*38.2*	12,112	*61.8*	0	*0*
1954	19,909	9,034	*45.4*	10,874[a]	*54.6*	0	*0*
1955	21,081	9,858	*46.8*	11,223[b]	*53.2*	0	*0*
1956	22,861	9,053	*39.6*	13,720	*60.0*	88	*0.4*
1957	22,979	9,222	*40.1*	13,665	*59.5*	92	*0.4*
1958	23,265	9,165	*39.4*	14,089	*60.6*	12	*0.1*
1959	26,059	10,913	*41.9*	15,141	*58.1*	4	*0.0*[c]
1960	24,935	10,531	*42.2*	14,383	*57.7*	21	*0.1*
1961	23,869	9,797	*41.0*	14,038	*58.8*	33	*0.1*
1962	28,149	11,175	*39.7*	16,708	*59.4*	266	*0.9*
1963	28,097	11,798	*42.0*	14,745	*52.5*	1,553	*5.5*
1964	32,007	12,292	*38.4*	15,714	*49.1*	4,002	*12.5*
1965	33,041	11,971	*36.2*	16,416	*49.7*	4,654	*14.1*
1966	33,429	10,626	*31.8*	18,120	*54.2*	4,683	*14.0*
1967	37,078	10,632	*28.7*	21,393	*57.7*	5,052	*13.6*
1968	40,951	9,690	*23.7*	20,915[d]	*51.0*	10,347[d]	*25.3*
1969	40,438	9,465	*23.4*	22,130[d]	*54.7*	8,843[d]	*21.9*
1970	42,330	9,080	*21.4*	19,342[d]	*45.7*	13,908[d]	*32.9*
1971	44,997	9,262	*20.6*	19,732[d]	*43.8*	16,003[d]	*35.6*
1972	48,465	9,049	*18.7*	19,241[d]	*39.7*	20,175[d]	*41.6*
1973	50,967	9,695	*19.0*	18,235[d]	*35.8*	23,037[d]	*45.2*
1974	48,053	9,321	*19.4*	16,949[d]	*35.3*	21,783[d]	*45.3*
1975	48,099	8,929	*18.6*	19,796	*41.2*	19,373	*40.3*

Sources: Montana Oil and Gas Conservation Commission, *Annual Reports, 1950-1975*, and *Monthly Statistical Bulletin*, January to December 1975 (Helena, Montana).

[a] Includes approximately 9,000 barrels from South Dakota.

[b] Includes approximately 13,000 barrels from South Dakota.

[c] Less than 0.05 percent.

[d] Montana Oil and Gas Conservation Commission, unpublished revisions.

outlet southwards and is logically directed toward Billings. Much of the Canadian crude comes from nearby Alberta and enters Montana via the Glacier Pipeline, which also services the oil fields in the central and northcentral portions of the state.

Ironically, even though Montana refineries have become increasingly dependent on out-of-state sources, about one-half to two-thirds of the crude oil pumped from the wells in the state is transported elsewhere for refining.[2] There are no crude oil pipelines connecting the Williston Basin fields, in the far eastern portion of the state, to Montana refineries and most oil produced there is shipped toward the midwest.

Inputs of raw materials and outputs of finished products do not tell the whole story. The importance of an industry to the local economy is usually analyzed in terms of employment. Total employment in Montana refineries is presented in table 2.[3] The figures show that even though the output of refineries has grown significantly, employment has remained at about 1,000 to 1,200 workers. In fact, considering that these data are derived from a sample and the Montana Department of Labor and Industry, which publishes this series, rounds to the nearest hundred employees, the minor ups and downs from one year to the next may simply be statistical artifacts.

The growth of refining capacity was accompanied by little change in total employment, because large sums were invested in new technology, plants, and equipment. These actions, in effect, increased the average productivity

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[2] Ibid., tables 7 and 9.

[3] Employment in oil refineries refers to the Standard Industrial Classification (SIC) industry 29, Petroleum Refining and Related Industries. During the early sixties, this classification included several firms producing paving and roofing materials, but they employed a total of less than 25 workers. For all practical purposes, therefore, SIC 29 in Montana reflects employment in oil refineries.

Table 2

Average Annual Employment in Montana Refineries
1953-1975

Year	Average Annual Employment
1953	1,200
1954	1,200
1955	1,200
1956	1,200
1957	1,200
1958	1,000
1959	900
1960	900
1961	1,000
1962	1,000
1963	1,200
1964	1,200
1965	1,100
1966	1,000
1967	1,000
1968	1,000
1969	900
1970	1,100
1971	1,000
1972	1,000
1973	1,100
1974	1,100
1975	1,100

Source: Montana Department of Labor and Industry, Employment Security Division, "Employees on Montana Nonagricultural Payroll," *Montana Labor Market*, and "Annual Statewide Labor Force Report," *Montana Employment and Labor Force*, table C (Helena, Montana).

of workers and accounted for the increases in output. This trend was accentuated to some extent by the closing of most small (and usually inefficient) refineries during the past decades. The high labor productivity associated with these mechanized processes is one of the reasons for the above average incomes for oil refining workers, which will be examined in detail later.

The Structure of Montana's Oil Refining Industry

During the 1920s and 1930s, Montana had many small refineries located near the source of the oil and serving local markets. Technological and market developments in the 1940s, 1950s, and 1960s improved the competitive position of large refineries and led to the closing of most of the small plants. A summary of Montana's refining industry as it existed in 1975 is presented in table 3.[4] These figures show nine refineries in the state; two have been shutdown since 1972, leaving seven classified as operational. The shutdown refineries (Diamond Asphalt Co. near Chinook and Jet Fuel Refinery near Mosby) have capacities far less than the others and represent the type of small establishments prevalent 30 or 40 years ago.

The refining industry in Montana is dominated by the three large plants in the Billings area. Taken together they--Conoco, Exxon, and Farmers Union--accounted for almost 43 million barrels, about 89 percent of the total refined during 1975. The fourth largest plant, Phillips Petroleum Co. near Great Falls, refined approximately 2.1 million barrels, about one-fifth of the smallest Billings area refinery. The three remaining installations--Big West Oil Co., Tesoro Petroleum Co., and Westco Refining Co.--each refined between .69 million and 1.29 million barrels in 1975.

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[4] These figures are based on revised data provided by several refineries and are not exactly comparable to those shown in table 1.

Table 3

Crude Oil Refined in Montana in 1975, by Refinery and Source

Refinery	Location (City and County)	Total Crude Oil Refined (Millions of Barrels)	Source of Crude Oil					
			Montana		Wyoming		Canada	
			Barrels (Millions)	*Percentage of Total*	Barrels (Millions)	*Percentage of Total*	Barrels (Millions)	*Percentage of Total*
Big West Oil Co.	Kevin, Toole County	1.22[a]	0.40[a]	*32.7*	0.00	*0.0*	0.82[a]	*67.3*
Continental Oil Co.	Billings, Yellowstone County	16.47[b]	3.29[b]	*20.0*	4.22[b]	*25.6*	8.96[b]	*54.4*
Diamond Asphalt Co.	Chinook, Blaine County	-----[c]						
Exxon Co. (formerly Humble Oil)	Billings, Yellowstone County	15.10	0.88	*5.8*	8.61	*57.0*	5.61	*37.2*
Farmers Union	Laurel, Yellowstone County	11.18	1.47	*13.1*	5.37	*48.1*	4.34	*38.8*
Jet Fuel Refinery	Mosby, Garfield County	-----[d]						
Phillips Petroleum Co.	Great Falls, Cascade County	2.16	1.73	*80.0*	0.00	*0.0*	0.43	*20.0*
Tesoro Petroleum Co. (formerly Texstar Petroleum and Texas-Calgary Company)	Wolf Point, Roosevelt County	0.69	0.68	*98.6*	0.00	*0.0*	0.01	*1.4*
Westco Refining Co. (formerly Union Oil)	Cut Bank, Glacier County	1.31[a]	1.14[a]	*87.0*	0.00	*0.0*	0.17[a]	*13.0*
Total		48.13	9.59	*19.9*	18.20	*37.8*	20.34	*42.3*

Source: Montana Oil and Gas Conservation Commission, *Monthly Statistical Bulletin*, January-December 1975 (Helena, Montana).

[a] Incorporates revisions provided by Thunderbird Petroleums, Inc.

[b] Incorporates revisions provided by the Continental Oil Co.

[c] Currently shutdown; 1972 production about 144,000 barrels.

[d] Currently shutdown; 1972 production about 19,000 barrels.

Canadian oil flows to all Montana refineries. The Big West Oil Co. refinery is the most dependent, with over two-thirds of its crude coming from across the border. The three large Billings area plants rely heavily on Canadian crude oil; Continental Oil Co. for 54 percent of its total and Exxon Co. and Farmers Union for 37 and 39 percent, respectively. Phillips Petroleum Co. in Great Falls relies somewhat less on imports, about 20 percent of its crude came from Canada. Only Westco Refining Co., with 13 percent, and tiny Tesoro Petroleum Co., with about one percent, are relatively independent of foreign sources.

Characteristics of Refinery Jobs

Large oil refineries are designed for continuous operation. It is inefficient and costly to open or close refineries in response to short-run variations in market demand. In the past, these production conditions were one of the reasons behind gas wars and the proliferation of independent service stations as the refining companies tried to dispose of their excess supplies--a situation which may not be repeated as the United States enters a period of relative scarcity of petroleum. These same factors, however, have given stability to oil refining jobs. The annual data in table 2 displayed none of the cyclical ups and downs often associated with industrial employment. In addition, monthly employment statistics for oil refineries show no significant seasonal patterns within a calendar year; almost 82 percent of refinery employees worked 50 to 52 weeks during 1969, as compared to approximately 55 percent for all of manufacturing workers.[5]

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[5] Montana Department of Labor and Industry, Employment Security Division, "Annual Statewide Labor Force Report," Montana Employment and Labor Force, various years (Helena, Montana), table C. U.S. Department of Commerce, Bureau of the Census, U.S. Census of Population: 1970, Detailed Characteristics, Montana, Final Report PC(1)-D28 (Washington, D.C.: U.S. Government Printing Office, 1972), table 185.

It was mentioned earlier that the significant increases in plant and equipment have led to high labor productivity and above average earnings for oil refinery workers. The extent of income advantage is shown in table 4, which reports that average annual earnings for oil refinery workers in Montana was $16,900 during 1973. This is almost double the $8,700 per year earned by the average nonagricultural worker. (Agriculture is excluded because the ups and downs in this industry makes comparisons for a single year hazardous.) Similarly, the average earnings in wood products and food processing, two of Montana's other major manufacturing industries, are far below that of oil refineries.

Average annual earnings data may overstate the attractiveness of refinery jobs when measured in terms of take-home pay. Refinery workers receive considerable fringe benefits in the form of employer contributions to pension plans. These payments are categorized as other labor income and are included in earnings despite the fact that they may not be reflected in a person's paycheck. While fringe benefits also are included in the earnings figures for workers in the other industries listed in table 4, they may comprise a smaller percentage of the total.

In summary, oil refineries provide very high quality jobs for Montanans. These positions are not subject to seasonal or cyclical fluctuations and are among the best paying in the state.

Refineries and the Economy

Economists conceptually divide an economy into primary and derivative sectors. Primary industries are those which depend heavily on outside markets or are otherwise influenced by factors originating beyond the borders of the area under study. The major examples are agriculture, mining, certain types of manufacturing, railroads, and the federal government.

Table 4

Average Annual Earnings in Refineries and Selected Industries
Montana
1973

Industry	Average Annual Earnings per Worker
Refineries (SIC 29)	$16,900
Nonagricultural industries, total	8,700
Manufacturing, total	9,600
Lumber and wood products (SIC 24)	8,900
Food and kindred products (SIC 20)	8,600
Federal civilian government	12,100

Sources: [Employment] Montana Department of Labor and Industry, Employment Security Division, "Annual Statewide Labor Force Report, 1973," *Montana Employment and Labor Force*, table C (Helena, Montana, March 1975). U.S. Department of Commerce, Bureau of the Census, *U.S. Census of Population: 1970, Detailed Characteristics, Montana,* Final Report PC(1)-D28 (Washington, D.C.: U.S. Government Printing Office, 1972), table 186. U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economics Information System, unpublished data (Washington, D.C.), provided through Montana Department of Community Affairs (Helena, Montana). [Earnings] U.S. Bureau of Economic Analysis, *Survey of Current Business* (August 1975), p. 20. Earnings per worker were derived.

Notes: Earnings includes wages and salaries, other labor income, and proprietors' income. SIC numbers in parenthesis are the Standard Industrial Classification code.

Derivative industries, on the other hand, primarily serve the local population and include such businesses as wholesale and retail trade, the services, and local governments. Economists believe that most economic growth in small areas can be attributed to events outside that region which influence primary industries and that changes in derivative industries can be traced to changes in those primary industries. Therefore, the refineries may be analyzed in terms of their role as a primary industry, or, stated differently, their contribution to the local economic base.

Refineries and Montana's Economy. When viewed at the state level, Montana's refineries cannot be unambigously classified as either a primary or derivative industry since only about one-third the gasoline and other distillates are shipped to out-of-state markets.[6] This fact, by itself, suggests that refineries belong in the derivative sector. On the other hand, refineries are different from other derivative industries in that they may not respond to changes in local conditions. For example, a sharp decline in Montana's demand for gasoline may not lead to a reduction in refineries output. Instead, oil companies may simply ship their excess supplies to another state. In short, while Montana's refineries may not be export industries in the strict sense, they definitely do not belong in the derivative sector and should be considered as part of the state's economic base.

The relative importance of an industry to a local economy is often analyzed in terms of employment. This procedure may not be appropriate for refineries, however, because these workers have high average earnings. That is, the true importance of refineries may be understated by simply comparing numbers of jobs. Consequently, the role of this industry in the economy will be examined in terms of both employment and earnings.

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[6] Montana Energy Advisory Council, table 10.

The earnings and employment data in table 5 may be used to compare refineries to Montana's other primary industries. Agriculture is shown separately because of its unique characteristics. There has been a long-run decline in farm and ranch employment--due primarily to increased mechanization and consolidation--and agricultural earnings vacillate significantly from one year to the next; thus figures for a single year may not truly represent the long-run trend. Nonagricultural primary employment could not be precisely estimated and total employment in mining, manufacturing, and the federal government is presented as a proxy.[7]

Looking first at employment, the figures in table 5 show that the number of workers in mining, manufacturing, and the federal government grew from 37.7 thousand in 1960 to 44.8 thousand in 1974, a rise of about 19 percent. During the same period, refinery employment grew from 900 to 1,100 workers. Technically, this was a 22.2 percent increase. Turning back to the annual data presented in table 2, however, suggests that the increase may be overstated due to the process of rounding figures to the nearest hundred and that 1960 may not be a good base year. A more realistic conclusion is that oil refinery employment has remained constant during the past decade as compared to a moderate growth in other nonagricultural primary industries.

The earnings data paint a different picture. Earnings in oil refineries rose from $12.0 million in 1960 to $20.5 million in 1974, an increase

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[7] Total mining, manufacturing, and federal government employment is not exactly comparable to the earnings of nonagricultural primary industries which could be calculated from available data. To make the state-level definition comparable to the regional definition presented later, the employment in certain primary industries is excluded if it is available only as a statewide total, i.e., railroads.

Table 5

Employment and Earnings in Refining, Agriculture, and Selected Primary Industries in Montana 1960, 1970, and 1974

	1960	1970	1974	*Percent Change* 1960-1970	*Percent Change* 1970-1974	*Percent Change* 1960-1974
Employment (thousands)						
Refining[a]	0.9	1.1	1.1	*22.2*	*0.0*	*22.2*
Agriculture[b]	39.2	36.1	35.1	*-8.5*	*-2.8*	*-11.6*
Mining, manufacturing, and the federal government[a]	37.7	41.8	44.8	*10.9*	*7.2*	*18.8*
Earnings (millions)						
Refining	$ 12.0	$ 16.8	$ 20.5	*40.0*	*22.0*	*70.8*
Agriculture	183.0	323.3	513.6	*76.6*	*58.9*	*180.7*
Nonagricultural primary industries, total[c]	331.4	532.7	763.9	*60.7*	*43.4*	*130.5*

Sources: [Earnings] U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economics Information System, unpublished data (Washington, D.C.), partially furnished through Montana Department of Community Affairs (Helena, Montana). [Employment] Montana Department of Labor and Industry, Employment Security Division, *Annual Statewide Labor Force Report*, selected issues (Helena, Montana).

[a] Wage and salary workers only.

[b] Includes farm proprietors and wage and salary workers.

[c] Includes the federal government, railroads, mining, and selected portions of manufacturing and construction.

of 70.8 percent. Total nonagricultural primary earnings grew from $331.4 million in 1960 to $532.7 million in 1970 and then increased further to $763.9 million in 1974, an overall growth of almost 131 percent.[8] Between 1970 and 1974 oil refinery earnings grew by 22.0 percent, slightly greater than the 20.7 percent increase experienced by all nonagricultural primary industries.

What do all these numbers mean? Simply stated, refineries are relatively unimportant in a statewide context; their employment and earnings in 1974 represented only between two and three percent of the total for all nonagricultural primary industries. When compared to Montana's other primary industries, total refinery earnings and employment generally grew at a slower rate during the 1960-1974 period. This apparent slow growth may be misleading. The other industries experienced expanding employment and the addition of new firms. Refinery employment was stable primarily because of technical factors but there were significant increases in total earnings.

Refineries and the Billing's Economy. Yellowstone County (Billings) contains the three largest refineries representing almost 90 percent of the crude oil processed in Montana. This section takes a closer look at these firms and examines their role in the Billing's economy. Before proceeding, however, it should be mentioned that there is no doubt that these refineries belong in the economic base of Yellowstone County because most of their output is transported outside the county.

The analysis of refineries in Yellowstone County begins with 1967 because it is the earliest year for which county data are available. Estimated refinery employment in Yellowstone County, shown in table 6,

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[8] A detailed description of the nonagricultural primary industries is presented in Paul E. Polzin, "An Income Model for the State of Montana," Bureau of Business and Economic Research, University of Montana, Missoula, 1974, table 1.

Table 6

Employment and Earnings in Refining, Agriculture, and Selected Industries
Yellowstone County
1965, 1970, and 1974

	1967	1970	1974	Percent Change 1967-1970	Percent Change 1970-1974	Percent Change 1967-1974
Employment						
Refining[a]	920	990	990	7.6	0.0	7.6
Agriculture[b]	1,832	1,709	1,689[c]	-7.2	-1.1	-8.5
Mining, manufacturing, and federal government[d]	5,056	5,273	5,870[c]	4.3	11.3	16.1
Earnings (thousands)						
Refining	$12,634	$15,422	$18,600	22.1	20.6	47.2
Agriculture	9,100	16,954	16,318	86.3	-3.9	79.3
Nonagricultural primary industries[e]	56,027	62,328	93,582	11.2	50.1	67.0

Sources: [Earnings] U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economics Information System, unpublished data (Washington, D.C.), partially furnished by Montana Department of Community Affairs (Helena, Montana). [Employment] Estimated from information provided by U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economics Information System, unpublished data (Washington, D.C.), partially furnished by Montana Department of Community Affairs (Helena, Montana), and Montana Department of Labor and Industry, Employment Security Division, unpublished data (Helena, Montana).

[a] Estimated employment.

[b] Includes farm proprietors and wage and salary workers.

[c] Employment figures for 1974 were not yet available at the time this report was prepared, so 1973 figures were used here.

[d] Wage and salary workers only.

[e] Includes the federal government, railroads, mining, and selected portions of manufacturing and construction.

grew from 920 to 990 workers between 1967 and 1970 and remained at that level until 1974.[9] A change of only 70 workers is within the margin of error associated with this data and it appears safe to conclude that refinery employment in the Billings area remained approximately constant during this seven year period. In comparison, total mining, manufacturing, and federal government employment in Yellowstone County increased from 5,056 workers to 5,870 workers, or 16.1 percent, between 1967 and 1974.

As at the state level, total earnings of refinery workers increased substantially, even though the number of workers did not. The same was true in Yellowstone County; the figures were $12.6 million in 1967 and $18.6 million in 1974, a 47.2 percent increase. Total earnings of all workers in nonagricultural primary industries increased by 67 percent between 1967 and 1974, from $56.0 million to $93.6 million. Table 6 indicates that the growth rate for the total earnings of refinery workers exceeded that of all nonagricultural primary earnings during the early part of the period, 1967-1970, and fell behind during 1970-1974.

The 990 refinery workers accounted for almost 17 percent of the total employed in mining, manufacturing, and the federal government in Yellowstone County during 1974. The corresponding calculation for earnings, which takes into account the high wages and other compensations associated with these jobs, reveals that the $18.6 million paid to refinery workers was almost 20 percent of the total for nonagricultural primary industries. In other words, refineries represent about 15 to 20 percent of the nonagricultural economic base in Yellowstone County.[10] In fact, refineries represent the largest single industry in the nonagricultural primary sector of the local economy.

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[9] Refinery employment was estimated using the statewide data prepared by the Montana Department of Labor and Industry and the county earnings data prepared by the U.S. Bureau of Economic Analysis, Regional Economic Information System.

The Role of Montana's Small Refineries. The four refineries located outside Yellowstone County account for about 10 percent of the total industry employment and crude oil refined. Despite their relatively small size, several are located in rural communities and represent a significant portion of the local nonagricultural economic base. Unfortunately, a complete analysis could not be performed because federal and state laws prohibit the release of information for a single firm. This means that employment and earnings data for these refineries is not available. The approximate employment for each refinery was obtained, however, through the assistance of the Montana Petroleum Association and is shown in table 7. Even though they are not exact, these figures should provide a rough measure of employment during the last few years. For comparison, the number of workers during 1973 in agriculture and other primary industries is also presented; federal government employment is shown separately because of unique situations in several of these counties.

The Phillips Petroleum Co. in Cascade County employs 50 to 60 workers as compared to 1973 total employment of 9,563 in mining, manufacturing, and the federal government. Even allowing for Malmstrom Air Force Base, representing about 5,400 workers and significantly inflating the figures for

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[10] Both nonagricultural primary earnings and total employment in mining, manufacturing, and the federal government understate the local economic base because they do not take into consideration Billings' role as a regional trade center. A more accurate estimate, which is very time-consuming and expensive to derive, would include portions of the trade and services industries.

Table 7

Employment in Refining and Other Primary Industries
Selected Montana Counties
1973

	Cascade County	Glacier County	Roosevelt County	Toole County
Refinery	Phillips Petroleum	Westco Refinery	Tesoro Refinery	Big West Oil
Employment				
Refining[a]	50-60	40-45	15-20	35-40
Agriculture[b]	1,465	599	1,016	655
Other primary industries, total	9,563	749	347	310
Mining and manufacturing	1,836	468	145	244
Federal government[c]	7,727	281	202	66

Sources: [Refining] Montana Petroleum Association and individual members. [All other employment] U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economics Information System, unpublished data (Washington, D.C., 1975).

[a] Estimated.

[b] Wage and salary workers plus farm proprietors.

[c] Includes 5,415 federal military employees, primarily at Malmstrom AFB.

federal government employment, the Phillips Petroleum Co. represents a minor part of the nonagricultural economic base of Cascade County.

The Westco Refining Co. in Glacier County employs about 40 to 45 workers, representing approximately six percent of the total employment of approximately 750 in mining, manufacturing, and the federal government. The true importance of this firm to the local economy base may, however, be understated by including the federal government with the other primary industries. Glacier County contains much of the Blackfeet Indian Reservation and the 281 federal workers may include a significant number of U.S. Bureau of Indian Affairs personnel. When compared to just the private nonagricultural primary industries, the 40 to 45 Westco employees represent about ten percent of the total for mining and manufacturing.

A similar situation exists for Tesoro Petroleum Co. because Roosevelt County contains portions of the Fort Peck Indian Reservation. If federal government employment is excluded, the 15 to 20 employees of Tesoro Refinery represent over 10 percent of the total for the private nonagricultural industries (mining plus manufacturing).

Big West Oil Co. is located in Toole County and represents a significant portion of the nonagricultural economic base. Its 35 to 40 employees account for over eleven percent of total employment in mining, manufacturing, and the federal government.

Projected Economic Impact of Crude Oil Supply Alternatives

The Canadian National Energy Board has an announced policy that natural resources will be first allocated to domestic users. Exports from Canada will be allowed only if a definite surplus can be proven. It appears likely, therefore, that the supply of Canadian crude oil to Montana refineries may be in serious jeopardy.

This section examines the implications of the Canadian policy in terms of the projected impacts on earnings and employment in Montana. Throughout this analysis it is assumed that processed petroleum products, such as gasoline and fuel oil, will be available to Montanans in sufficient quantities and at reasonable prices so that no secondary repercussions would be felt elsewhere in the economy. In other words, the natural problems associated with the allocation and distribution of crude oil and petroleum products among and between states is not considered.

The Canadian policy with respect to crude oil and petroleum products has yet to be precisely defined. In order to facilitate orderly analysis, the Montana Energy Advisory Council (MEAC) formulated a series of alternatives which incorporate likely interpretations of Canadian policy and other developments relating to Montana refineries. A brief description of the alternatives is as follows:

I. No Canadian imports, no replacement. This is the worst possible case. All Canadian petroleum imports would be curtailed and Montana refineries would be unable to obtain domestic or international replacement.

II. No Canadian imports, some replacement from the continental United States. This assumes that additional quantities of crude oil are extracted somewhere in the continental U.S. and would include, for example, the increase in crude oil if further offshore drilling were permitted.

III. Canadian policy allows condensate to be exported to the United States, but full curtailment of crude oil. Condensate is a liquid byproduct of natural gas production and is used by some refineries in much the same manner as crude oil. (Canadian condensate is included in the data for crude oil in tables 1 and 3.) This represents a softening of the Canadian position from one of full curtailment of petroleum exports.

IV. The Northern Tier Pipeline is built to transport Alaskan crude oil. The proposed Northern Tier Pipeline would run from Port Angeles, Washington, to Minnesota, crossing Montana from west to east. It could connect with existing crude oil pipelines to supply Montana refineries.

V. Construction of a Canadian west coast port facility and pipeline to Edmonton, Alberta, to bring Alaskan crude oil via the existing Canadian pipeline system. This is the Price Rubert, British Columbia, to Edmonton, Alberta, pipeline which has been proposed as a less costly alternative to the Northern Tier Pipeline. It could supply Alaskan crude oil to Montana refineries through the existing pipeline system.

The MEAC's supply alternatives do not specify when the events will take place due to the uncertainty surrounding the Canadian export policy. According to various rumors, for example, the possible curtailment of Canadian imports could be anytime from 1977 to 1982. The projection method begins by translating the supply alternatives into "once and for-all" declines in refinery employment and earnings. The resulting changes in earnings and employment in derivative industries are then computed. All monetary values are converted to constant 1973 dollars to eliminate the effects of inflation.

Table 8

Projected Change in Montana Refinery Employment under Various Crude Oil Supply Alternatives

	Projected Change in Refinery Employment		
	Yellowstone County	All Other Counties	Montana Total
Alternative I--no Canadian imports, no replacement	-450	-45	-495
Alternative II--no Canadian imports, some United States (continental) replacement	-450	-45	-495
Alternative III--softening of the Canadian position for condensate, but full curtailment of crude oil	-270	-45	-315
Alternative IV--Northern Tier Pipeline bringing in Alaskan crude oil	-10	-45	-55
Alternative V--Canadian west coast port facility and pipeline to Edmonton, Alberta, bringing Alaskan crude to Montana via existing Canadian pipeline system	-10	-45	-55

Notes: The alternatives were prepared by the Montana Energy Advisory Council (Helena, Montana).

Estimating the impact of MEAC's supply alternatives on Montana refineries required that certain technical aspects be considered. In the first place, most refineries are designed for continuous operation and a partial reduction in their supply of crude oil may cause some to close. For example, if a refinery lost 33 percent of its crude oil supply, it might cease operations entirely rather than operate at two-thirds capacity. The critical "shutdown" point varies from one refinery to another depending on its equipment and other factors.

Secondly, the change in refinery employment may not be proportional to the change in inputs or outputs. A refinery may require a certain number of workers to remain open, regardless if it is operating at partial or full capacity. Therefore, significant reductions in level of production may be associated with only minor changes in refinery employment.

Finally, some refineries are designed to process specific types of crude oil and may not be able to use substitutes. The availability of Alaskan crude oil in alternatives IV and V may, therefore, be immaterial for some because the oil cannot be processed with existing equipment.

The estimated change in refinery employment associated with each of the crude oil supply alternatives is shown in table 8. Because of the concentration of the industry in the Billings area, separate figures are shown for Yellowstone County with the remaining refineries combined in the all other category. Even though individual refineries are not identified, the analysis considered the technical features of each installation and the probable reaction of each firm to the alternatives. Nevertheless, these projections are at best a "guesstimate" of the impact on refinery employment of the crude oil supply alternatives.

The figures in table 8 show three different changes in refinery employment associated with the five crude oil supply alternatives prepared by MEAC.

Alternatives I and II both involve statewide declines of 495 refinery workers; the increased availability of crude oil specified in alternative II was judged to have no effect on the Montana refineries.[11] Alternative III suggests a decline of 315 refinery workers; the softening of the Canadian position with respect to condensate may allow a Billings refinery to remain in operation. Alternatives IV and V, which assume that Alaskan crude oil will be available, are associated with a decrease of only 55 refinery workers, reflecting the closing of one of the small refineries and less than full-capacity operations at a Billings installation.

The impacts on the refinery industry are not the end of the story. These declines are a reduction in the primary industries that will lead to further decreases in the derivative sector. That is, there will be cutbacks in the services, retail and wholesale trade, and other locally oriented businesses as fewer dollars are spent and respent in the economy. Earlier studies have estimated that a $1 increase or decrease in primary earnings will lead to corresponding changes of $1.70 in statewide derivative earnings and $1.40 in derivative earnings in Yellowstone County.[12] These figures suggest that a $10,000 decline in the earnings of Billings refinery workers, for example, would lead to an additional decrease of $14,000 in derivative earnings in Yellowstone County and a total loss of $17,000 in statewide derivative earnings.

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[11] For example, a company may have ownership of crude oil off the coast of Louisiana with no pipeline to its Montana refinery. In the past, such situations were resolved by the trading of crude oil among companies. Given the current conditions, however, this solution was judged unlikely.

[12] Paul E. Polzin, "An Income Model for the State of Montana," p. 15. __________, Water Use and Coal Development in Eastern Montana, Bureau of Business and Economic Research, University of Montana, 1974, p. A-6. The figure of 1.4 was estimated for a seven county area in southcentral Montana and may slightly overstate the change in just Yellowstone County.

The change in derivative employment depends on the exact jobs which are affected. The $14,000 decline in Yellowstone County derivative earnings, for example, would correspond to the loss of two jobs if each paid $7,000 per year, or 1.4 jobs at $10,000 per year. In order to allow for this uncertainty, two projections were made for the change in derivative jobs. The first assumes that the affected positions would be similar to the average derivative job in Montana and paid $6,300 per year in constant 1973 dollars.[13] The second projection corresponds to the change in Full Time Equivalent (FTE) workers earning $8,800 per year in constant 1973 dollars; that is, each person worked 40 hours a week for 50 weeks a year.[14]

The primary and derivative changes in employment and earnings associated with each of the crude oil supply alternatives are shown in tables 9 and 10. Projections were made for both the state of Montana and Yellowstone County. Similar calculations could not be performed for the four smaller refineries because multipliers have not been estimated for these areas.

The figures in table 9 show that supply alternatives I and II are associated with a decrease of 495 jobs and $8,366,000 (1973 dollars) in earnings for Montana's refinery industry. The resulting declines in derivative earnings and employment is projected to be about $14,222,000 (1973 dollars) and from 1,620 to 2,260 jobs. The total impact including

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[13] U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Information Systems, Washington, D.C., unpublished data, 1975. Derivative earnings derived.

[14] Many derivative jobs, especially those in the trade and service industries, are part-time or seasonal. On the average, derivative employees in Montana worked about 1,425 hours during 1973. Full Time Equivalent earnings are calculated as follows: (2,000/1,425) x $6,300 = 1.40 x $6,300 = $8,820. Average weekly hours are reported in Montana Department of Labor and Industry, Employment Security Division, Montana Labor Market, Supplement II (Helena, Montana), and weeks worked per year are shown in U.S. Department of Commerce, U.S. Census of the Population: 1970, table 185.

Table 9

Projected Changes in Employment and Earnings in Montana under Various Crude Oil Supply Alternatives

	Alternatives		
	I and II	III	IV and V
Refineries			
Employment	-495	-315	-55
Earnings (1973 dollars)	$-8,366,000	$-5,324,000	$-930,000
Derivative industries			
Employment[a]	-1,620 to -2,260	-1,030 to -1,440	-180 to -250
Earnings (1973 dollars)	$-14,222,000	$-9,051,000	$-1,581,000
All industries, total			
Employment[a]	-2,115 to -2,755	-1,345 to -1,755	-235 to -305
Earnings (1973 dollars)	$-22,588,000	$-14,375,000	$-2,511,000

Note: The crude oil supply alternatives are defined in table 8.

[a] The greater employment change corresponds to the assumption that the derivative jobs are similar to existing positions while the smaller employment changes are the declines in full-time equivalent (FTE) positions.

Table 10

Projected Changes in Employment and Earnings in Yellowstone County under Various Crude Oil Supply Alternatives

	Alternatives		
	I and II	III	IV and V
Refineries			
Employment	-450	-270	-10
Earnings (1973 dollars)	$-7,605,000	$-4,563,000	$-169,000
Derivative industries			
Employment[a]	-1,210 to -1,690	-730 to -1,010	-30 to -40
Earnings (1973 dollars)	$-10,647,000	$-6,388,000	$-237,000
All industries, total			
Employment	-1,660 to -2,140	-1,000 to -1,280	-40 to -50
Earnings (1973 dollars)	$-18,252,000	$-10,951,000	$-406,000

Note: The crude oil supply alternatives are defined in table 8.

[a] The greater employment change corresponds to the assumption that the derivative jobs are similar to existing positions while the smaller changes are the declines in full-time equivalent (FTE) positions.

the changes in both primary and derivative industries would involve decreases of about $22,588,000 (1973 dollars) in statewide earnings and between 2,115 and 2,755 jobs. Similarly, alternative III will lead to a total decline of $14,375,000 (1973 dollars) in earnings and 1,345 to 1,755 jobs. Finally, alternatives IV and V correspond to a loss in the primary plus the derivative industries of about $2,511,000 (1973 dollars) in earnings and from 235 to 305 in employment.[15]

Turning next to Yellowstone County, the projections for alternatives I and II show a total decline in primary and derivative industries of $18,252,000 (1973 dollars) in earnings and from 1,660 to 2,140 in employment. Alternative III is projected to result in total decreases of $10,951,000 (1973 dollars) in earnings and between 1,000 and 1,280 jobs. Finally, alternatives IV and V are associated with a loss in the primary plus the derivative industries of only $406,000 (1973 dollars) in earnings and from 40 to 50 workers.

These projections may be put into perspective by comparing them to total employment of 303,100 in Montana and 44,500 in Yellowstone County during 1975.[16] The greatest impact is the projected statewide employment decline of 2,755 workers in primary and derivative industries associated with alternatives I and II. This represents less than one percent of total employment in Montana. It appears safe to conclude, therefore, that even the worst possible case--a complete curtailment of Canadian imports with no replacement--would have only a minor effect on total employment in Montana.

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[15] For simplicity, the projections for Yellowstone County were computed using the earnings per derivative worker for Montana. There is some evidence that figure for Yellowstone County differs slightly from the statewide average and would result in minor changes in estimate of derivative employment. But, the potential errors were judged to be small in light of the overall uncertainties and the rough nature of the data.

[16] Montana Department of Labor and Industry, Employment Security Division, Montana Employment and Labor Force (Helena, Montana), March 1976.

The projected impacts are not negligible, however, in Yellowstone County. Alternatives I and II are projected to result in declines of 1,660 to 2,140 workers in primary and derivative industries, representing between 3.7 and 4.8 percent of total employment in 1975. The intermediate alternative--a softening of the Canadian export policy with respect to condensate--is projected to lead to a total employment reduction of between 1,000 and 1,280, or about 2.2 to 2.9 percent of total employment. The loss of 40 to 50 workers associated with alternatives IV and V, which assume the availability of Alaskan crude oil, would amount to less than one half of one percent of total employment. In short, the curtailment of Canadian crude oil and condensate is projected to have significant impacts on the economy of Billings, which are likely to be moderated only by the introduction of Alaskan crude oil.

The projected losses of derivative jobs may appear excessive in light of the moderate decline in primary employment. As shown in table 9, for example, each refinery job lost is projected to decrease statewide derivative employment by 3.3 to 4.6 workers. The large impact per job is due to the high average earnings of refinery workers; corresponding declines in other primary industries with lower earnings per worker would lead to smaller decreases in derivative employment. This illustrates once again that refinery workers, although they are few in number, are very important to the economy.

The Northern Tier Pipeline in alternative IV would have an impact on the local economy, in addition to that associated with a change in refinery jobs. This facility is only in the early planning stage, none of the affected governments have given approval nor has the economic feasibility been definitely established. Nevertheless, the Northern Tier Pipeline is a very real possibility and information has been provided to make "ballpark" estimates of its impact in terms of employment and earnings.

The economic impact of the proposed Northern Tier Pipeline would consist of two parts. The first component is the additional earnings and employment associated with construction; these effects are transitory and will cease once the pipeline is built. The second component is the earnings and employment of the permanent employees concerned with the operation of the pipeline; they represent a long-run increase in the primary sector of the economy.

The exact features of the proposed Northern Tier Pipeline have not yet been released. Nevertheless, there is enough information to broadly sketch some of the important characteristics as they relate to Montana's economy.[17] As presently conceived, the Northern Tier Pipeline will cross Montana for 622 miles. When fully operational, in five to seven years, the 40 inch pipeline will have a cpacity of about 800,000 barrels per day and there will be seven pumping stations situated along the route. Permanent employment will consist of about 18 workers, concerned mostly with the maintenance of the pumping stations, each earning about $8,800 (1973 dollars) per year. The building phase will last for two construction seasons--approximately April to November, depending on the weather--and employ 400 to 500 Montana workers with total earnings of about $16,000,000 (1973 dollars) per year.[18] These figures should be interpreted with caution, there may be some inconsistencies or inaccuracies at this early stage of the planning process-for example, the implied earnings per construction worker is over $32,000 (1973 dollars) per year--but, they provide estimates of the approximate orders of magnitude for the construction and operations phases of this project.

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[17] The following information was kindly supplied by the Northern Tier Pipeline Company, Billings, Montana.

[18] In terms of current (1976) dollars, the total earnings of construction workers would be approximately $19,620,000 per year.

Except for its duration, the economic impact of construction is analogous to change in a primary industry and, with a few modifications, may be projected in the same manner. That is, the earnings of construction workers may be considered as additional primary income which will be spent and respent in the local area, causing increased derivative earnings and employment. The major question is how much derivative earnings will increase as a result of an additional dollar of construction earnings? Construction workers are notoriously mobile, moving from one site to another while maintaining a home and family elsewhere. Others may bring their wives and children but will not remain long enough to become part of the local community. Finally, local residents hired for a brief period may view their earnings as windfall gains, not spending them in the same manner as their usual income. All of these reasons suggest that, dollar for dollar, construction earnings will have a smaller impact on the derivative sector than equivalent (permanent) increases in the primary sector. There is evidence that this has been true for other major construction projects.[19] Therefore, following earlier precedents, it will be assumed that derivative earnings resulting from a change in construction earnings will be one-half that for other primary industries.[20] That is, $1.00 of construction earnings will increase derivative earnings in Montana by $.85, one-half the value used to compute the projections in table 9.

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[19] Mountain West Research Inc., Construction Worker Profile, Final Report, A Study for the Old West Regional Commission, Denver, 1975, pp. 104-107.

[20] Paul E. Polzin, Water Use and Coal Development in Eastern Montana, pp. 127-128.

The projected impacts of the Northern Tier Pipeline on statewide earnings and employment are shown in table 11. Separate projections for Yellowstone County could not be derived. The impacts of the first and second year of the construction phase are shown separately even though they are identical. During each of these years, the $16,000,000 (1973 dollars) in construction worker earnings will lead to an additional $13,600,000 (1973 dollars) in earnings and from 1,550 to 2,160 new jobs in the derivative industries. The combined primary plus derivative effects during the two year construction phase will amount to about $29,600,000 (1973 dollars) per year in earnings and between 1,950 and 2,660 new jobs in Montana. Once the pipeline is in operation, the 18 permanent employees earning $158,400 (1973 dollars) per year will lead to about $269,300 per year in earnings and from 30 to 45 new jobs in the derivative industries. Total primary plus derivative increases will amount to about $427,700 (1973 dollars) per year in earnings and an additional 48 to 63 new workers in Montana due to the operation of the Northern Tier Pipeline.

Despite the fact that they are based on rough data, these projections put the various aspects of the proposed Northern Tier Pipeline into perspective. In the first place, even though the construction phase is transitory, the increased earnings and employment associated with it will be many times greater than the operations phase. When it comes to long run impacts, the total primary plus derivative increase of between 48 and 63 workers associated with the pipeline operation falls short of the projected decline of 235 to 305 workers due to the effects on refineries shown in table 9 (alternative IV). In other words, there probably will not be

Table 11

Projected Montana Impact from Proposed Northern Tier Pipeline

	Construction Phase First Year	Construction Phase Second Year	Operations Phase (Annual)
Primary industries			
Construction employment	400-500	400-500	--------
Permanent employment	-----------	-----------	18
Earnings[a]	\$16,000,000	\$16,000,000	\$158,400
Derivative industries			
Employment[b]	1,550 to 2,160	1,550 to 2,160	30 to 45
Earnings[a]	\$13,600,000	\$13,600,000	\$269,300
All industries, total			
Employment[b]	1,950 to 2,660	1,950 to 2,660	48 to 63
Earnings[a]	\$29,600,000	\$29,600,000	\$427,700

Note: The impact of construction will terminate after two years. The impact of the operations phase represents the annual impact for the lifetime of the pipeline, corresponding to full capacity (which may not be attained for several years after the beginning of the operations phase).

[a] 1973 dollars.

[b] The greater employment change corresponds to the assumption that the new derivative jobs are similar to existing positions while the smaller employment change is the increase in full-time equivalent (FTE) positions.

sufficient new permanent positions associated with the proposed pipeline to counterbalance the declines in employment due to the inability of certain refineries to process Alaskan crude oil.